

## **General Disclaimer**

### **One or more of the Following Statements may affect this Document**

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.
- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.
- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.
- This document is paginated as submitted by the original source.
- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

**VOLUME**

**3**

**NASA CR-152566**

CONTRACT NO. NAS8-31690  
27615-6007-RU-01  
DR-SE-02A

# **INTERFACE CONTROL DOCUMENTS (ICD)**

## **BOOK 1 - AMPS EQUIPMENT TO ORBITER ICD**

(NASA-CR-152566) ATMOSPHERE, MAGNETOSPHERE  
AND PLASMAS IN SPACE (AMPS). SPACELAB  
PAYLOAD DEFINITION STUDY. VOLUME 3; BOOK 1:  
AMPS EQUIPMENT TO ORBITER ICD Final Report  
(TRW Defense and Space Systems Group) 12 p

N77-28169

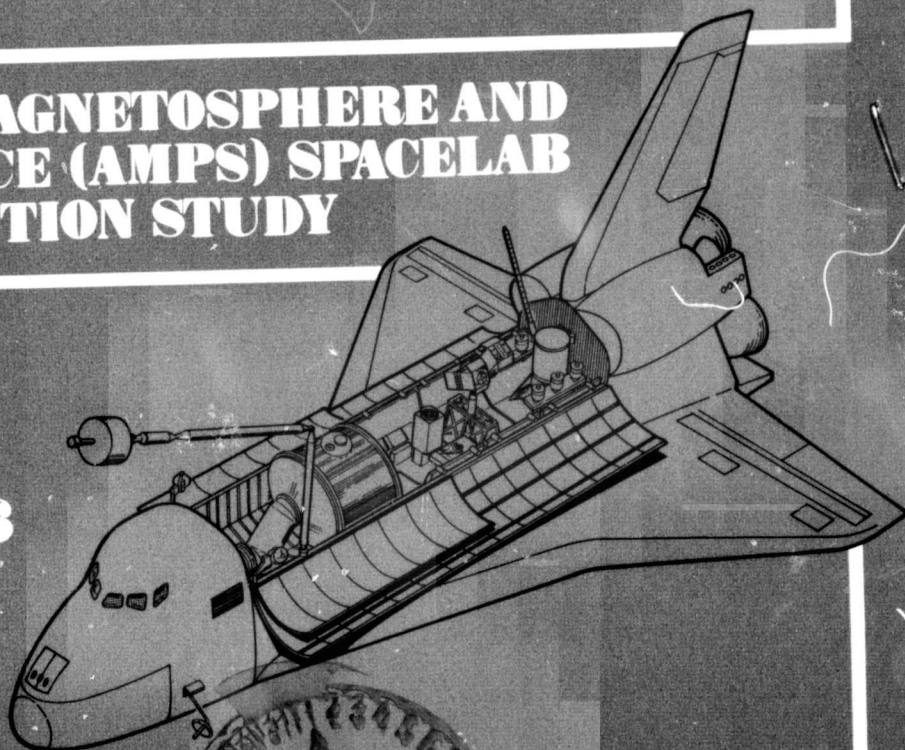
HC A02/MF A01

Unclas

G3/12 39998

## **ATMOSPHERE, MAGNETOSPHERE AND PLASMAS IN SPACE (AMPS) SPACELAB PAYLOAD DEFINITION STUDY**

**Final Report  
November 1976**



Prepared for  
National Aeronautics  
and Space Administration  
Goddard Space Flight Center  
Greenbelt, Maryland 20771



**TRW**  
DEFENSE AND SPACE SYSTEMS GROUP

ATMOSPHERE, MAGNETOSPHERE AND PLASMAS IN SPACE (AMPS)  
SPACELAB PAYLOAD DEFINITION STUDY  
FINAL REPORT

VOLUME III  
BOOK 1 - AMPS EQUIPMENT TO ORBITER ICD

Document No.  
27615-6007-RU-01  
DR-SE-02A

November 1976

Approved by:

*W. F. Rector, III*

W.F. Rector, III  
Project Manager, AMPS

Prepared for

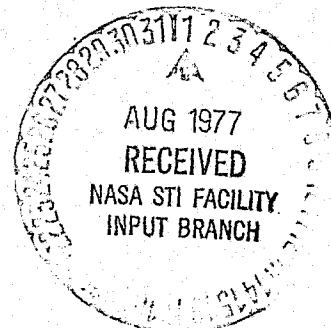
National Aeronautics and Space Administration  
Goddard Space Flight Center  
Greenbelt, Maryland 20771

Contract No. NAS8-31690

**TRW**

DEFENSE AND SPACE SYSTEMS GROUP

ONE SPACE PARK · REDONDO BEACH, CALIFORNIA 90278



## CONTENTS

|                                    | Page |
|------------------------------------|------|
| 1. SCOPE                           | 1    |
| 2. APPLICABLE DOCUMENTS            | 1    |
| 2.1 Overriding Documents           | 1    |
| 2.2 Applicable Documents           | 1    |
| 3. INTERFACES                      | 2    |
| 3.1 Physical Interfaces            | 2    |
| 3.1.1 Payload Bay Installation     | 2    |
| 3.1.2 Aft Flight Deck Installation | 2    |
| 3.1.3 Cable and Utility Lines      | 2    |
| 3.2 Electrical Interfaces          | 2    |
| 3.2.1 Electrical Power             | 2    |
| 3.2.2 Communications               | 2    |
| 3.2.3 Data Interfaces              | 2    |
| 3.3 Thermal Interfaces             | 2    |

## 1. SCOPE

This document defines the physical, thermal, and electrical interfaces that exist between Spacelab-AMPS Payload No.(TBD) and the Orbiter. The characteristics specified herein are based on the definition of Spacelab and Orbiter as of the date of issue of this document. Subsequent changes in the Spacelab or Orbiter which affect the AMPS payload may require revision of this document.

## 2. APPLICABLE DOCUMENTS

The following documents are applicable to the extent noted.

### 2.1 OVERRIDING DOCUMENTS. In case of conflict, the following documents supersede any requirements stated herein:

- (a) JSC 07700 Volume XIV, Revision D, change 16, entitled: "Space Shuttle Payload Accommodation.
- (b) NASA/ESA Shuttle Vehicle/Spacelab Interface Control Documents:
  - (1) ICD-2-05301 Avionics Interfaces
  - (2) ICD-2-05101 Structural/Mechanical Interfaces
  - (3) Others (TBD).

### 2.2 APPLICABLE DOCUMENTS. The following documents of the exact issue noted are applicable to the extent specified herein:

- (a) NASA/ESA SLP/2104, dated PDR-B 1976, entitled: Spacelab Payload Accommodation Handbook.

### 3. INTERFACES

#### 3.1 PHYSICAL INTERFACES. This section covers the physical interfaces in the payload bay, on the Orbiter flight deck, and elsewhere on the Orbiter.

- 3.1.1 Payload bay installation. Figure 3.1-1 shows the payload installed in the payload bay, the hard-points used, the clearances between the payload and Orbiter, the c.g. location, and other details of the physical interfaces in the payload bay.
- 3.1.1.1 Payload manifest. Table III.I-1 is a summary manifest of payload equipment by category including mass properties and c.g. locations.
- 3.1.1.2 Orbiter optional equipment. Table III.I-2 identifies the optional Orbiter equipment required to support the payload and further identifies those items which are expendable.
- 3.1.2 Aft flight deck installation. Figure 3.1-2 shows the physical location and installation details for all payload equipment mounted on the aft flight deck. Also included are tabulated data on the mass properties of all payload hardware.
- 3.1.3 Cable and utility lines. Table III.I-3 shows the routing, tiedown, and other physical details related to cabling and utility lines which interface with the Orbiter.

#### 3.2 ELECTRICAL INTERFACES

- 3.2.1 Electrical power. Figure 3.2-1 shows the wiring interfaces, loads, grounding, and other details of the interface between the payload and Orbiter. This figure also shows emergency loads and fault protection provided by the payload.
- 3.2.2 Communications. Table III.II-1 shows the type, format, bit rate, signal level and other details of data streams which interface with the Orbiter uplink/forward link.
- 3.2.3 Data interfaces. Table III.II-2 identifies payload interfaces with the Orbiter avionics including the intercom, CCTV, GN&C, MTU, PDI, PSP, MDM, payload interrogator, the MSS PCM recorder, and the payload wideband recorder.

#### 3.3 THERMAL INTERFACES. Figure 3.3-1 contains a description of the thermal model used in analysis of the payload when installed in the Orbiter; shows temperature predictions for typical operating modes; shows the location of temperature sensors; and illustrates other features of the thermal interface. This figure includes specific details of the thermal interface between payload equipment on the Orbiter flight deck and the Orbiter itself, and identifies any special thermal requirements which might impact the Orbiter configuration.

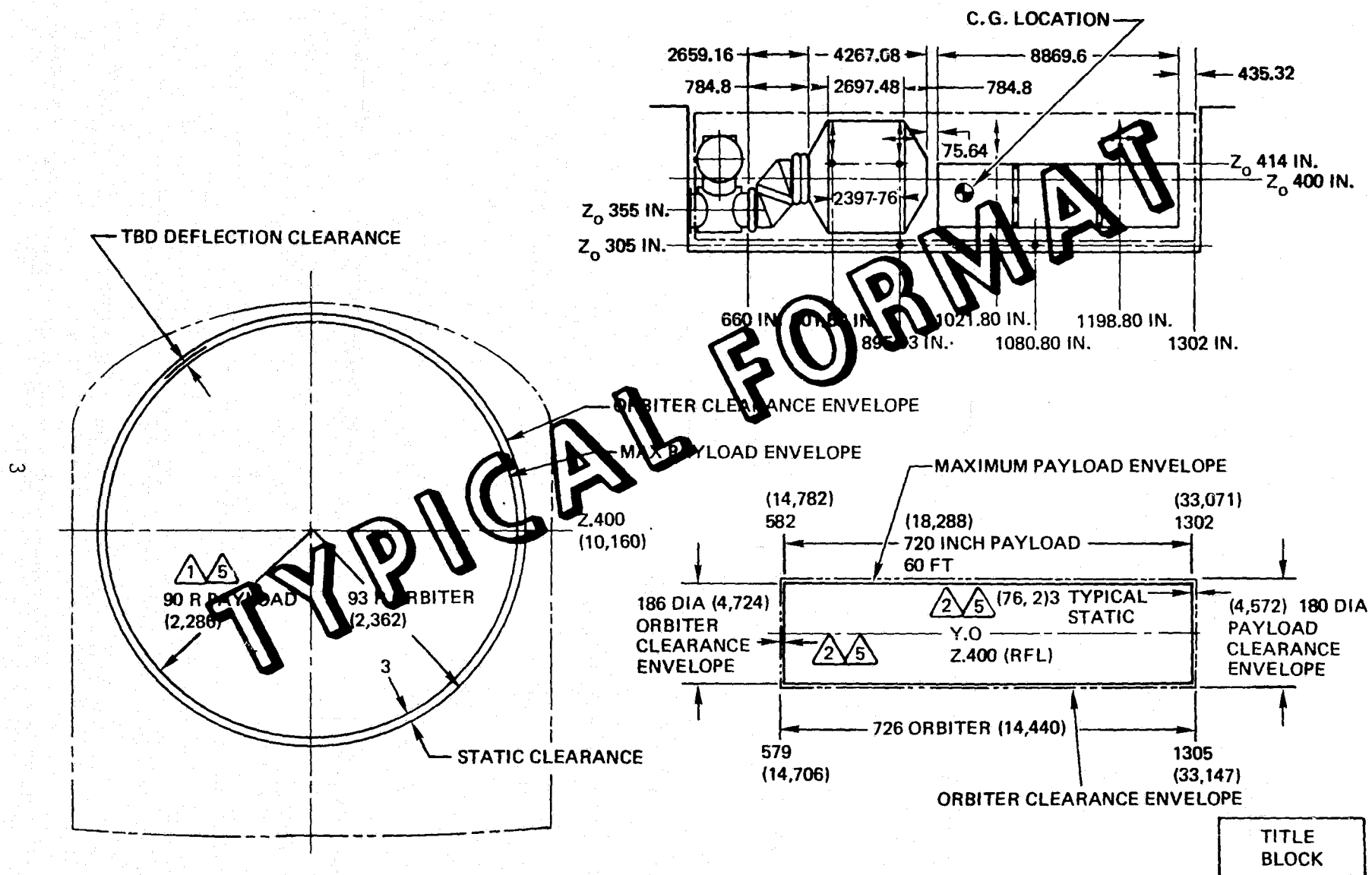


Figure 3.1-1. Payload Installation

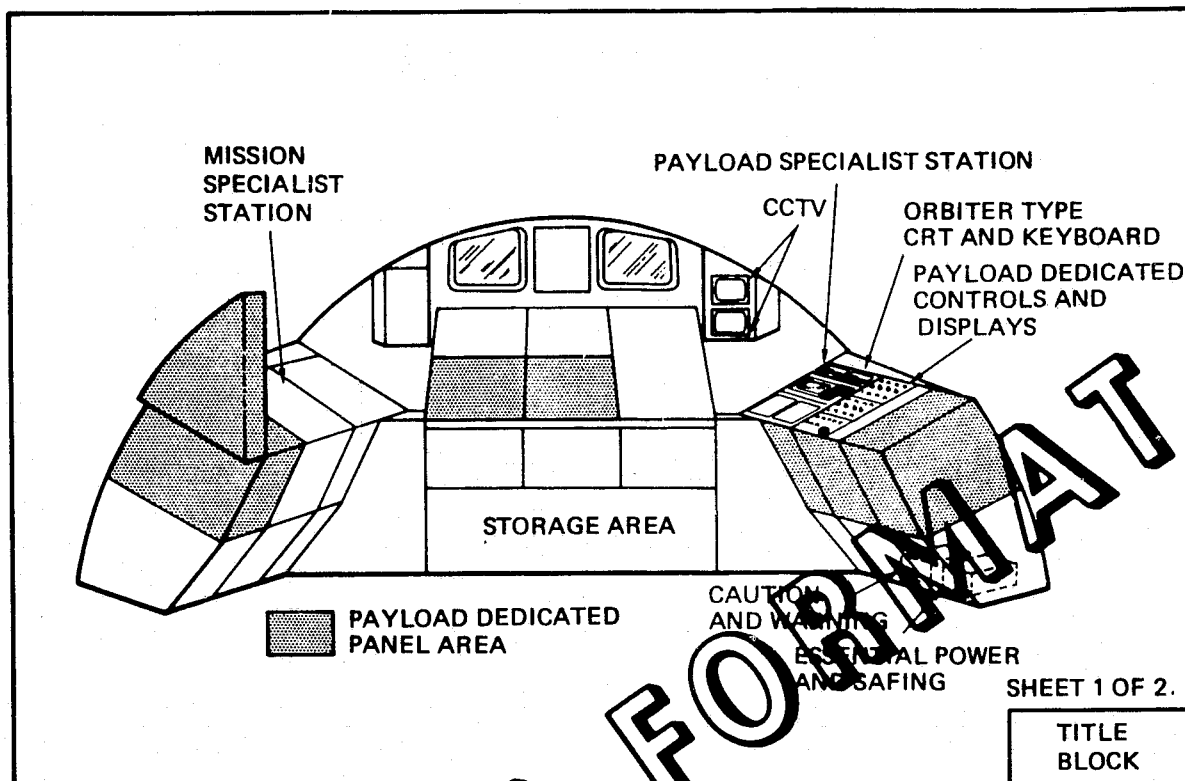
Table III.I-1. Payload Manifest

| EQUIPMENT<br>CATEGORY | EQUIP.<br>DESC | LAUNCH<br>WEIGHT<br>(KG) | LANDING<br>WEIGHT<br>(KG) | CG LOCATION    |                |                | NOTES |
|-----------------------|----------------|--------------------------|---------------------------|----------------|----------------|----------------|-------|
|                       |                |                          |                           | X <sub>0</sub> | Y <sub>0</sub> | Z <sub>0</sub> |       |
| SPACELAB MIE          |                |                          |                           |                |                |                |       |
| SPACELAB MDE          |                |                          |                           |                |                |                |       |
| LABCRAFT              |                |                          |                           |                |                |                |       |
| INSTRUMENT            |                |                          |                           |                |                |                |       |
| MMSE                  |                |                          |                           |                |                |                |       |
| OPTIONAL ORBITER      |                |                          |                           |                |                |                |       |
| OTHER                 |                |                          |                           |                |                |                |       |
| TOTALS                |                |                          |                           |                |                |                |       |

Table III.I-2. Optional Orbiter Equipment

| EQUIP.<br>DESC | QUANTITY | WEIGHT<br>(KG) | CG LOCATION |   |   | NOTES                     |
|----------------|----------|----------------|-------------|---|---|---------------------------|
|                |          |                |             |   |   |                           |
| RMS            | —        | —              | —           | — | — | NOT PAYLOAD<br>CHARGEABLE |
| ESS KIT, (S)   |          |                |             |   |   |                           |
| OMS KIT        |          |                |             |   |   |                           |
| TUNNEL ADAPTER |          |                |             |   |   |                           |
| DOCKING MODULE |          |                |             |   |   |                           |
| 2ND RMS        |          |                |             |   |   |                           |
| ATS RAD KIT    |          |                |             |   |   |                           |
| CREW           |          |                |             |   |   |                           |
| MSS RECORDER   |          |                |             |   |   |                           |
| ETC            |          |                |             |   |   |                           |





OAFD PAYLOAD EQUIPMENT

| EQUIP<br>DESC | WEIGHT | CG LOCATION    |                |                | NOTES |
|---------------|--------|----------------|----------------|----------------|-------|
|               |        | X <sub>0</sub> | Y <sub>0</sub> | Z <sub>0</sub> |       |
|               |        |                |                |                |       |
|               |        |                |                |                |       |
|               |        |                |                |                |       |
|               |        |                |                |                |       |
|               |        |                |                |                |       |
|               |        |                |                |                |       |
|               |        |                |                |                |       |
|               |        |                |                |                |       |
| TOTAL         |        |                |                |                |       |

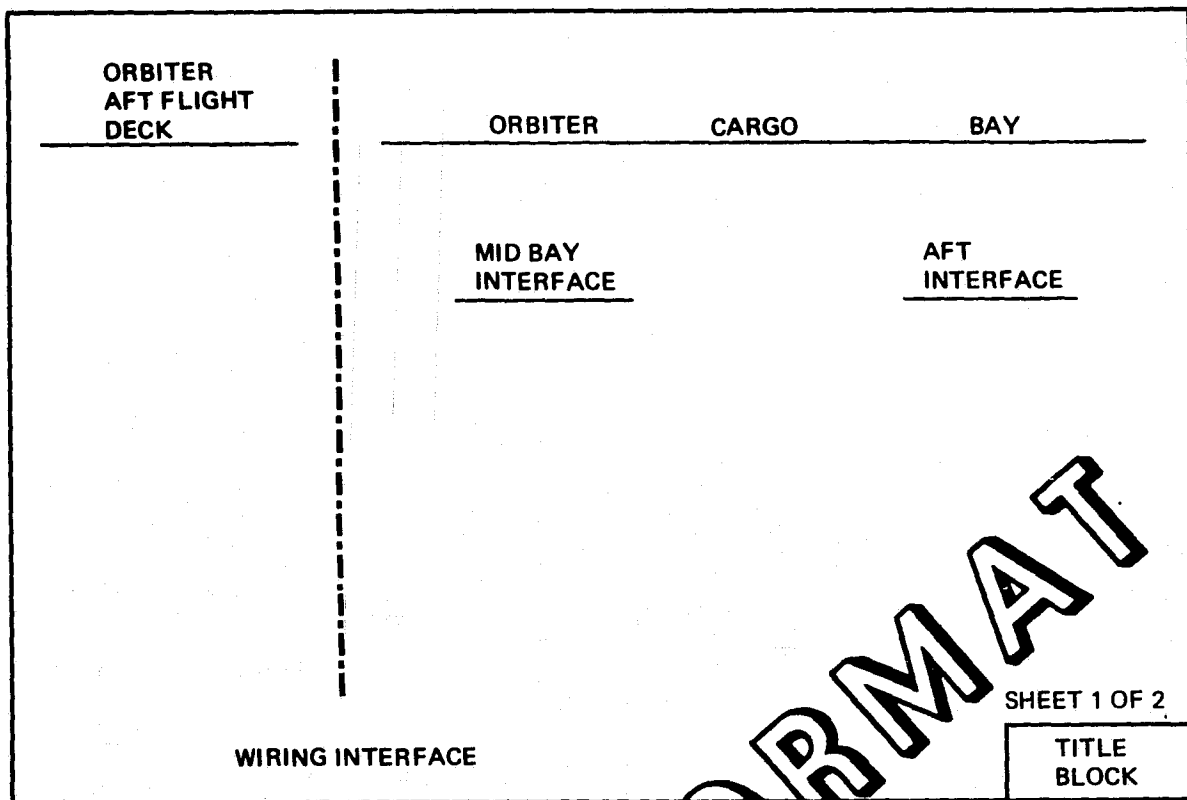
SHEET 2 OF 2

TITLE BLOCK

Figure 3.1-2. OAFD Payload Equipment Installation

Table III.I-3. Cable and Utility Line Routing

| FLIGHT___CABLE AND UTILITY LINE ROUTING                                                                                                                                                                                                                                          |                 |                      |      |                                              |                                              |                       |                   |                     |         |      |  |                |  |         |     |       |  |      |  |          |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------|----------------------------------------------|----------------------------------------------|-----------------------|-------------------|---------------------|---------|------|--|----------------|--|---------|-----|-------|--|------|--|----------|--|
| CABLE<br>(ID)                                                                                                                                                                                                                                                                    | CABLE<br>LENGTH | CONNECTOR<br>ROUTING |      | PHYSICAL ROUTING                             |                                              |                       |                   |                     |         |      |  |                |  |         |     |       |  |      |  |          |  |
|                                                                                                                                                                                                                                                                                  |                 | FROM                 | TO   | FROM                                         | TO                                           | BEND                  | TIEDOWN           | THERMAL<br>COVERING | REMARKS |      |  |                |  |         |     |       |  |      |  |          |  |
| CL-01                                                                                                                                                                                                                                                                            | 20.16M          | JM-1                 | JP-1 | X <sub>1</sub> Y <sub>1</sub> Z <sub>1</sub> | X <sub>2</sub> Y <sub>1</sub> Z <sub>2</sub> | 90° AT X <sub>2</sub> | 2' INTER-<br>VALS | NONE                |         |      |  |                |  |         |     |       |  |      |  |          |  |
| <div style="position: absolute; top: 50%; left: 50%; transform: translate(-50%, -50%) rotate(-45deg); font-size: 100px; opacity: 0.3; pointer-events: none;"> TYPICAL FORMAT </div>                                                                                              |                 |                      |      |                                              |                                              |                       |                   |                     |         |      |  |                |  |         |     |       |  |      |  |          |  |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2">SIZE</td> <td colspan="2">CODE IDENT NO.</td> <td>ICD-XXX</td> <td>REV</td> </tr> <tr> <td colspan="2">SCALE</td> <td colspan="2">DATE</td> <td colspan="2">DRAWN BY</td> </tr> </table> |                 |                      |      |                                              |                                              |                       |                   |                     |         | SIZE |  | CODE IDENT NO. |  | ICD-XXX | REV | SCALE |  | DATE |  | DRAWN BY |  |
| SIZE                                                                                                                                                                                                                                                                             |                 | CODE IDENT NO.       |      | ICD-XXX                                      | REV                                          |                       |                   |                     |         |      |  |                |  |         |     |       |  |      |  |          |  |
| SCALE                                                                                                                                                                                                                                                                            |                 | DATE                 |      | DRAWN BY                                     |                                              |                       |                   |                     |         |      |  |                |  |         |     |       |  |      |  |          |  |



| LOAD TABLE     |                         |                          |                               |                     |         |
|----------------|-------------------------|--------------------------|-------------------------------|---------------------|---------|
| LOAD<br>DESCR  | AVE<br>POWER<br>(WATTS) | PEAK<br>POWER<br>(WATTS) | EMERGENCY<br>POWER<br>(WATTS) | FAULT<br>PROTECTION | REMARKS |
|                |                         |                          |                               |                     |         |
|                |                         |                          |                               |                     |         |
|                |                         |                          |                               |                     |         |
|                |                         |                          |                               |                     |         |
| TOTALS         |                         |                          |                               |                     |         |
| SHEET 2 OF 2   |                         |                          |                               |                     |         |
| TITLE<br>BLOCK |                         |                          |                               |                     |         |

Figure 3.2-1. Electrical Power Interfaces

Table III.II-1. Payload Communications Formats

| DATA ID | DATE TYPE           | DATA FORMAT                      | DATA RATE  | DATA ROUTING |    | SIGNAL LEVEL | NOTES |
|---------|---------------------|----------------------------------|------------|--------------|----|--------------|-------|
|         |                     |                                  |            | FROM         | TO |              |       |
|         | ANALOG<br>(0-5 VAC) | SUBCOM<br>ON 1 MHz<br>SUBCARRIER | 5-1500 MHz |              |    |              |       |
|         | DIGITAL             | NRZ                              | 4 MBPS     |              |    |              |       |

Table III.II-2. Data Interfaces

| DATA TYPE   | DATA TYPE | DATA FORMAT | DATA RATE | DATA ROUTING |    | SIGNAL LEVEL | NOTES |
|-------------|-----------|-------------|-----------|--------------|----|--------------|-------|
|             |           |             |           | FROM         | TO |              |       |
| C&W<br>GN&C |           |             |           |              |    |              |       |

PHYSICAL DESCRIPTION OF  
THERMAL INTERFACES  
(TBD)

TITLE  
BLOCK

| FLIGHT _____ THERMAL MODEL |                |                             |                          |                        |            |                                         |       |
|----------------------------|----------------|-----------------------------|--------------------------|------------------------|------------|-----------------------------------------|-------|
| OPERATING<br>MODE          | COOLING<br>AIR | SUN<br>ANGLE<br>( $\beta$ ) | MODEL<br>ELEMENT<br>NAME | ELEMENT<br>DESCRIPTION | NODE<br>ID | T <sub>MAX</sub><br>OR T <sub>MIN</sub> | NOTES |
| PRE-LAUNCH                 |                |                             |                          |                        |            |                                         |       |
| ASCENT                     |                |                             |                          |                        |            |                                         |       |
| ASCENT                     |                |                             |                          |                        |            |                                         |       |
| ASCENT                     |                |                             |                          |                        |            |                                         |       |
| ON-ORBIT                   |                |                             |                          |                        |            |                                         |       |
| ON-ORBIT                   |                |                             |                          |                        |            |                                         |       |
| ON-ORBIT                   |                |                             |                          |                        |            |                                         |       |
| POST-LANDING               |                |                             |                          |                        |            |                                         |       |

Figure 3.3-1. Thermal Interfaces